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DESCRIPTION OF THE ACOUSTICAL INSTALLATIONS OF THE CENTER FOR TESTING OF PROPULSION SYSTEMS

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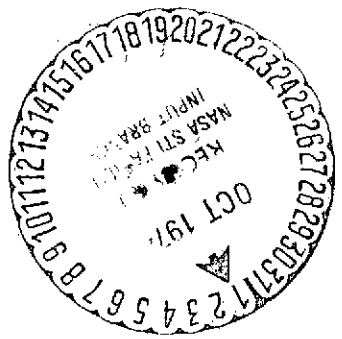

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16. Abstract

The soundproofing, aircirculation system and measurement device of the A17 anechoic chamber are described, as is the data processing system for measurements obtained in the chamber. An anechoic wind tunnel soon to be constructed will have similar characteristics to those of the anechoic chamber, buthwith improved capacity for simulation of real conditions.

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The A17 Anechoic Chamber /2*

The special characteristics of the anechoic chamber primarily concern the soundproofing, the air circulation system and the measurement device.

1. General Configuration and Soundproofing

The chamber is a parallelopipedal enclosure with internal dimensions of 14 x 10 x 4.5 m. The walls have been soundproofed for two purposes:

-- To protect the test chamber from noise and vibrations of outside origin. With a sound level of 106 dB outside, the sound level measured inside the chamber is 57 dB.

-- To absorb the noise emitted by the source studied, that is, to eliminate reflection so as to recreate the sound field which this source would produce if it were located in the open air at a distance from any obstacles. The error due to reflection is no more than 1 dB at 6 m from the model.

In order to obtain these results, the chamber is double-walled: the outer walls are composed of concrete 50 cm thick. The inner chamber rests on thispsupports on an intermediate layer of cork, and has a concrete floor and brick walls. The inner coating consists primarily of an air gap (resonator) and glass wool dihedrals which cover the floor, walls and ceiling.

*Numbers in the margin indicate pagination in the foreign text.

The only openings are:

-- The entrance door, composed of iron, wood and glass wool. This weighs seven tons and slides on rails. Joints are used to ensure airtightness.

-- The openings of the air circulation system, which will now be described.

2. Air Circulation System:

The anechoic chamber serves primarily to measure jet noise in pipes. Primary and secondary air intakes have thus been provided. The compressors used are able to supply air at pressures as high as 8 bars, for a total maximum flow rate of 6 kg/sec, or 3.5 bars for 20 kg/sec. A propane-burning combustion chamber makes it possible to produce generating temperatures ranging as high as 1,350°K. /3

The noise transmitted by these pipes, which is much less than that from the jets, may also be a disadvantage in some cases. A means of disassembling them is provided for cases when no flow is necessary.

The gas output consists of a soundproofed pipe (perforated sheet metal and glass wool).

A dilution airflow makes it possible to cool the chamber and to produce uniform inside temperature and humidity, facilitating computation of the atmospheric absorption. This air comes in through the ceiling, after passing through various bends and baffles for the purpose of sound damping. The jet in the pipe draws this air in by induction.

3. Sound Measurement

A microphone is placed on a boom which slides along a circular rail affixed to the ceiling of the chamber. It is thus possible to measure the sound field at any point located within a cylinder with a radius of 6 m and a height of 3.5 m, for an azimuth of between 15° and 165° in relation to the direction of the jet.

A spectral analysis system makes it possible to analyze the frequency of the sound spectrum from 200 Hz to 100 KHz.

The results obtained in this way undergo various processing operations in real time and in deferred time through the use of a completely automatic measurement chain. A graphic recorder furnishes the corresponding curves in real time.

Processing of Measurements Obtained in the Anechoic Chamber /4

The measurement chain transmits the data to the central computer, where it may undergo various processing operations.

1. Measurement Chain

The basic elements are:

-- microphone

-- amplifier

-- an analyzer, which, by means of a system of filters, makes it possible to determine the sound power levels in predetermined frequency bands

-- the computer, which processes the data and immediately

transmits certain results to the printer and to the graphic recorder located in the control room of the anechoich chamber.

For some types of special studies there are also:

-- a correlator;

-- a Fourier transformer.

2. Processing of Measurements

Several programs are used. Specifically:

-- Errors due to the measurement chain, obtained by calibration, are corrected. In addition, the sound spectrum which would be obtained in the absence of atmospheric absorption in the test enclosure is computed. This absorption depends on the temperature and the hygrometry, but mean values are frequently used.

-- The preceding results are transposed, taking the scale and standard atmospheric absorption into account. In this way one obtains the noise produced by the full-scale jet, at a distance fixed by the standards in force (450 m, for example) and in various directions.

-- It is also possible to calculate what the corrected noise level would be in a real case (transposed as indicated above) to determine the physiological effects (PNL, TPNL, etc.).

Noise Cells

/5

These are used to analyze the behavior of the components tested (piles, for example) in the presence of a high level sound field.

1. General Configuration

These are cement cells whose internal volumes are 12 cm^3 and 32 cm^3, respectively. The walls are not parallel, so that the characteristic vibrational modes of these chambers are attenuated.

2. Operation

The noise is produced by explosion of a compressed air jet through a pipe. The sound levels obtained range from approximately 145 to 155 dB, for a generating pressure on the order of 50 bars.

The air issues from a pressurized container at 250 bars. The assembly operates by gusts which can last as long as 10 min.

Variations in the overall sound level are recorded during these tests.

The A19 Anechoic Wind Tunnel /6

The fact that so many tests in the anechoic chamber have been requested over the last few years has resulted in plans for a new installation which will begin construction next June. The intention this time is to construct an anechoic wind tunnel in order to simulate the effects of flight speed. The current chamber was not set up for this type of simulation.

1. General Configuration

This will be a free-duct wind tunnel, with this duct located in a soundproofed enclosure. Thus the principal components, upstream to downstream, will be;

-- an admission noise suppressor,

-- a high contraction ratio converging pipe, preceded by a grid for maximum reduction of turbulence, since this is a particular disadvantage in sound testing.

-- a cylindrical free duct 2 m in diameter and 5 m long. The shape of the enclosure will be that of a quarter sphere with a radius of 9.6 m. The soundproofing device will be much simpler than that of the current installation, which was found to be excessive. There will be a monocoque cement chamber resting on shock absorbers, an air gap and dihedrals on the inside.

-- a diffuser followed by a noise suppressor.

-- The air feed device, which will probably consist of pumps, whose high-frequency noise can be damped more easily than that of a fan.

-- a final noise suppressor.

2. Operation

The rate of flow in the test duct will be 100 m/sec, which roughly corresponds to the take-off or approach speed of current airplanes.

The air feed device, consisting of tested pipes, will be analogous to that of the existing installation. /7

A cooling air intake with a flow rate of about 100 kg/sec will also be provided.

There will be no basic differences as to performance of measurements between this wind tunnel and the current chamber. It might be pointed out that it will be possible to move the microphone farther away from the model (up to approximately 8.5 m).

In addition, the measurement chain will be technically improved (presence of a minicomputer in the control room).

3. Conclusion

This installation will have an improved ability to simulate the real operating conditions of the jet pipes or noise suppressors which will be tested in it, and it will also make it possible to conduct more basic studies on the effects of flight speed, refraction and scattering of sound signals in the mixing zone.